

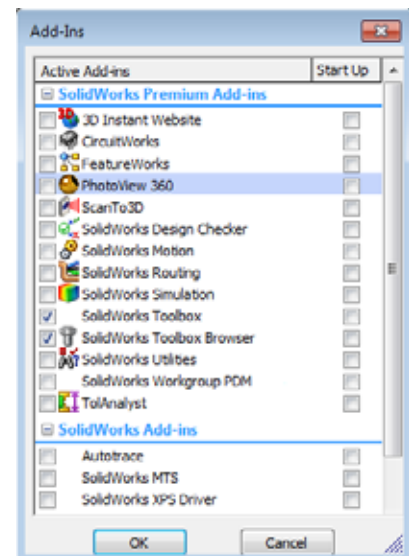
Lesson 5: SolidWorks Toolbox Basics

Goals of This Lesson

- ❑ Place standard SolidWorks Toolbox parts in assemblies.
- ❑ Modify Toolbox part definitions to customize standard Toolbox parts.

Before Beginning This Lesson

- ❑ Complete Lesson 4: Assembly Basics.
- ❑ Verify that **SolidWorks Toolbox** and **SolidWorks Toolbox Browser** are set up and running on your classroom/lab computers. Click **Tools, Add-Ins** to activate these add-ins. SolidWorks Toolbox and SolidWorks Toolbox Browser are SolidWorks add-ins which are not loaded automatically. These add-ins must be specifically added during installation.



Resources for This Lesson

This lesson plan corresponds to *Productivity Enhancements: Toolbox* in the SolidWorks Tutorials.



SolidWorks Toolbox contains 1000's of library parts including fasteners, bearings, and structural members.

Review of Lesson 4: Assembly Basics

Questions for Discussion

- 1 Describe an assembly.

Answer: An assembly combines two or more parts in a single document. In an assembly or sub-assembly, parts are referred to as components.

- 2 What does the command **Convert Entities** do?

Answer: **Convert Entities** projects one or more curves onto the active sketch plane. Curves can be edges of faces or entities in other sketches.

- 3 What does a selection filter do?

Answer: A selection filter enables you to more easily select the item you want in the Graphics Area by only allowing you to select a specified type of entity.

- 4 What does it mean when a component in an assembly is “fixed”?

Answer: A fixed component in an assembly cannot move. It is locked in place. By default, the first component added to an assembly is automatically fixed.

- 5 What are mates?

Answer: Mates are the relationships that align and position components in an assembly.

- 6 What are degrees of freedom?

Answer: Degrees of freedom describe how an object is free to move. There are six degrees of freedom. They are translation (movement) along the X, Y, or Z axes, and rotation around the X, Y, or Z axes.

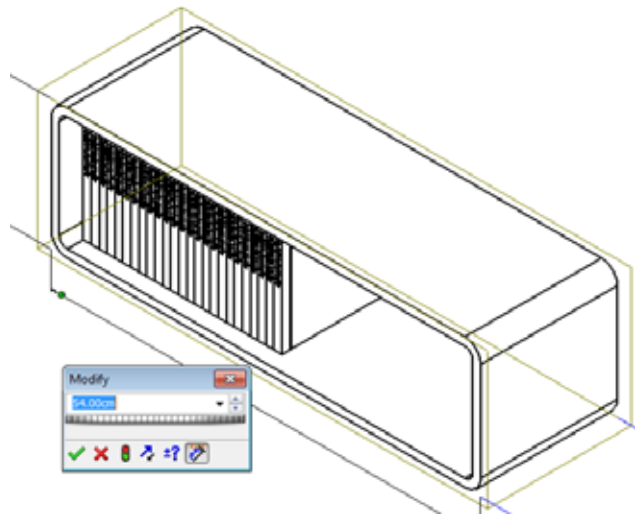
- 7 How are degrees of freedom related to mates?

Answer: Mates eliminate degrees of freedom.

In Class Demonstration — Changing an Assembly

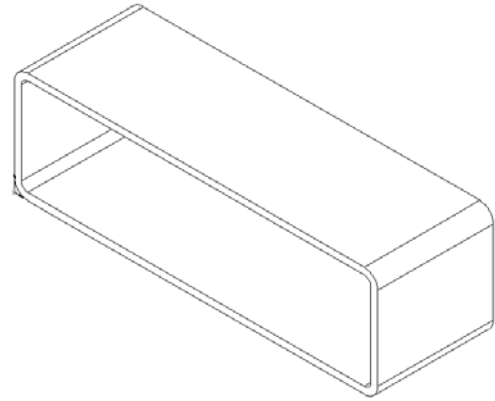
You receive a design change. The customer requires a storage box to hold 50 CD jewel cases.

- 1 Open the `cdcase-storagebox` assembly.
- 2 Double-click on the top face of the `storagebox` component.
- 3 Double-click the width dimension. Enter a new value, **54 cm**.
- 4 Rebuild.



- 5 Open storagebox. Review the modified part.

Notice that when feature dimensions are modified in the assembly, the components change to reflect the modification.



Optional:

Change the number of instances in the assembly component pattern to 50.

Outline of Lesson 5

- ❑ In Class Discussion — What is Toolbox?
- ❑ Active Learning Exercises — Adding Toolbox Parts
 - Open the Switchplate Toolbox Assembly
 - Open Toolbox Browser, in the Design Library Task Pane
 - Selecting Appropriate Hardware
 - Placing Hardware
 - Specifying the Properties of the Toolbox Part
- ❑ Exercises and Projects — Bearing Block Assembly
 - Opening the Assembly
 - Placing Washers
 - Placing Screws
 - Thread Display
 - Making Sure the Screws Fit
 - Modifying Toolbox Parts
- ❑ More to Explore — Add Hardware to an Assembly
- ❑ Lesson Summary

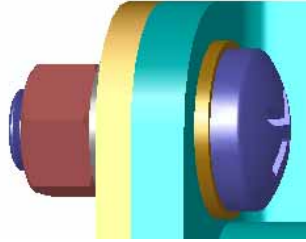
Competencies for Lesson 5

Students develop the following competencies in this lesson:

- ❑ **Engineering:** Select fasteners automatically based on hole diameter and depth. Utilize fastener vocabulary such as thread length, screw size, and diameter.
- ❑ **Technology:** Utilize the Toolbox Browser and display of thread style.
- ❑ **Math:** Relate diameter of screw to screw size.
- ❑ **Science:** Explore fasteners created from different materials.

In Class Discussion — What is Toolbox?

Toolbox includes a library of standard parts that are fully integrated with SolidWorks. These parts are ready-to-use components — such as bolts and screws.

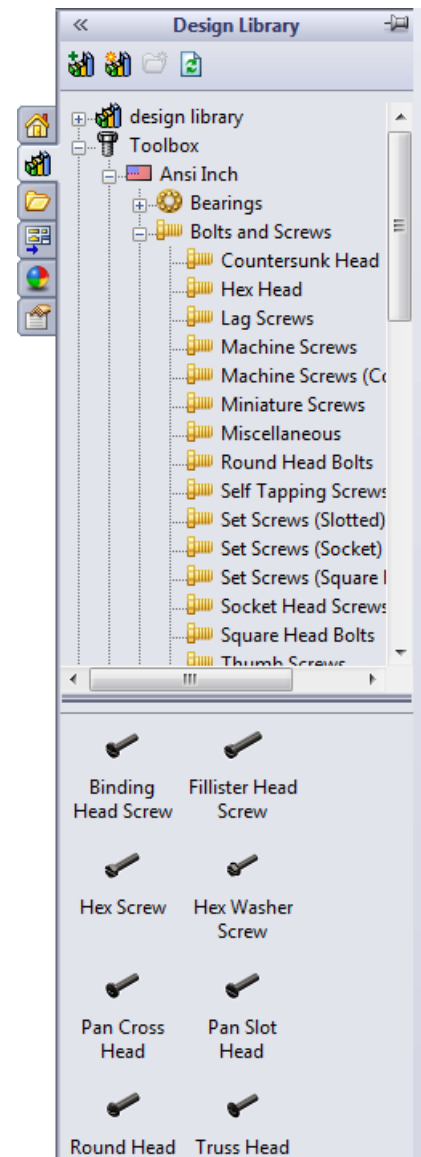


To add these parts to an assembly, select the type of part you want to insert, then drag the Toolbox part into your assembly. As you drag Toolbox parts, they snap to the appropriate surfaces — automatically establishing a mate relationship. In other words, a screw recognizes that it belongs in a hole and snaps to it by default.

As you are placing the Toolbox parts, you can edit the property definitions to correctly size the Toolbox part to your needs. Holes created with the hole wizard are easy to match with properly-sized hardware from Toolbox.

The Toolbox Browser library of ready-to-use parts saves you the time that you would usually spend creating and adapting these parts if you built them yourself. With Toolbox, you have a complete catalog of parts.

Toolbox supports international standards such as ANSI, BSI, CISC, DIN, ISO, and JIS. In addition, Toolbox also includes standard parts libraries from leading manufacturers such as PEM[®], Torrington[®], Truarc[®], SKF[®], and Unistrut[®].



Active Learning Exercises — Adding Toolbox Parts

Follow the instructions in *Productivity Enhancements: Toolbox* in the SolidWorks Tutorials. Then proceed with the exercise below.

Add screws to the switchplate using the predefined hardware in Toolbox.

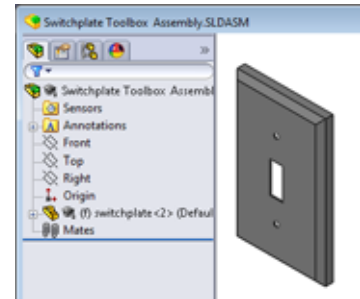
In the previous lesson, you added screws to the switchplate by modeling the screws and mating them to the switchplate in an assembly. As a general rule, hardware — such as screws — are standard components. Toolbox gives you the ability to apply standard hardware to assemblies without having to model it first.

Open the Switchplate Toolbox Assembly

Open the Switchplate Toolbox Assembly.

Notice that this assembly only has one part — or component — in it. Switchplate is the only part in the assembly.

An assembly is where you combine parts together. In this case, you are adding the screws to the switchplate.

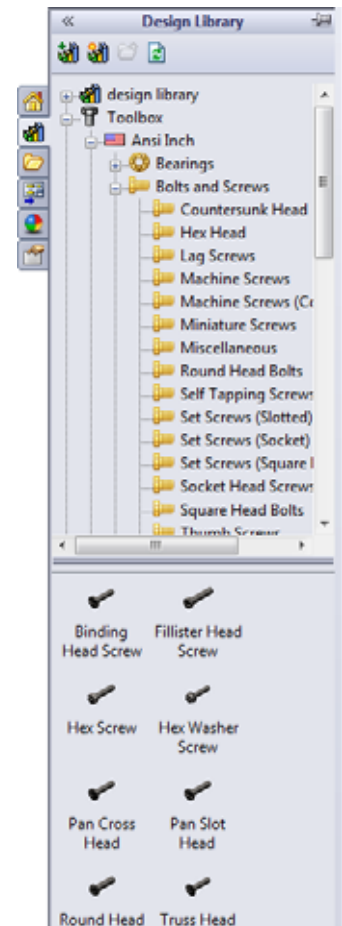


Open Toolbox Browser

Expand the Toolbox item  **Toolbox** on the Design Library Task Pane. The Toolbox Browser appears.

The Toolbox Browser is an extension of the Design Library that contains all available Toolbox parts.

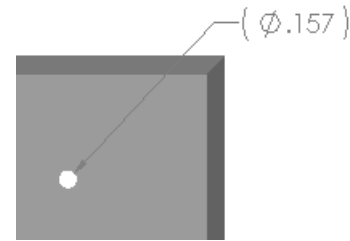
The Toolbox Browser is organized like a standard Windows Explorer folder view.




Selecting the Appropriate Hardware

Toolbox contains a wide variety of hardware. Selecting the right hardware is often critical to the success of a model.

You must determine the size of the holes before selecting the hardware to use and match the hardware to the hole.



- 1 Click **Evaluate > Measure**  and select one of the holes on the switchplate to determine the hole size.

Note: The dimensions in this lesson are shown in inches.

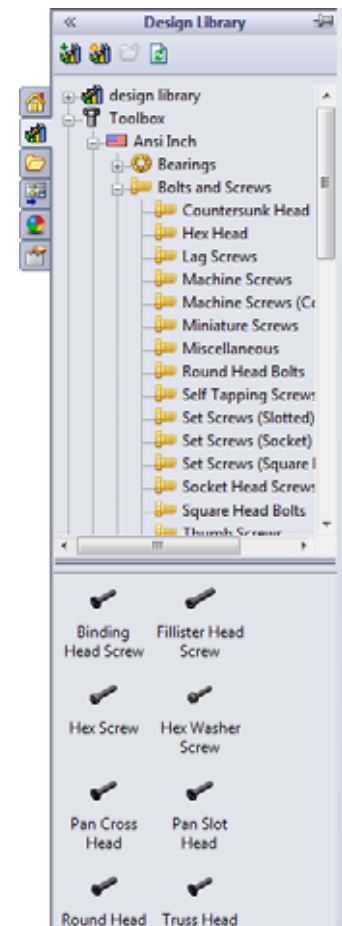
- 2 In the Toolbox Browser, browse to **Ansi Inch, Bolts and Screws, Machine Screws** in the folder structure.

The valid types of machine screws display.

- 3 Click and hold **Pan Cross Head**.

Does this hardware selection make sense for this assembly? The switchplate was designed with the size of the fasteners in mind. The holes in the switchplate are specifically designed for a standard fastener size.

The fastener size is not the only consideration in selecting a part. The type of fastener is important too. For example, you would not use miniature screws or square head bolts for the switchplate. They are the wrong size. They would be either too small or too large. You also have to take into consideration the user of this product. This switchplate has to be attachable with the most common of household tools.

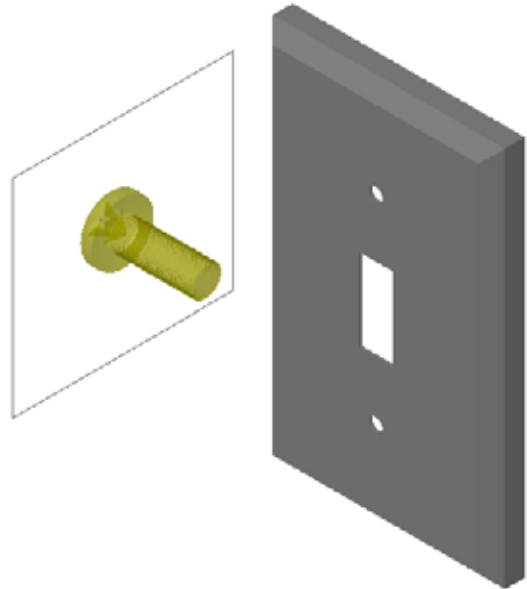


Placing Hardware

- 1 Drag the screw towards the switchplate.

As you begin to drag the screw, it may appear very large.

Note: Drag parts by holding the left mouse button. Release the mouse button when the part is correctly oriented.

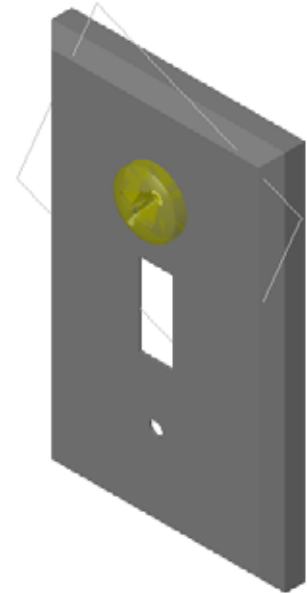


- 2 Slowly drag the screw towards one of the switchplate holes until the screw snaps into the hole.

When the screw snaps into the hole, it is correctly oriented and properly mates with the surfaces of the part that it is combined with.


The screw still may appear too large for the hole.

- 3 When the screw is in the correct position, release the mouse button.



Specifying the Properties of the Toolbox Part

After you release the mouse button, a PropertyManager appears.

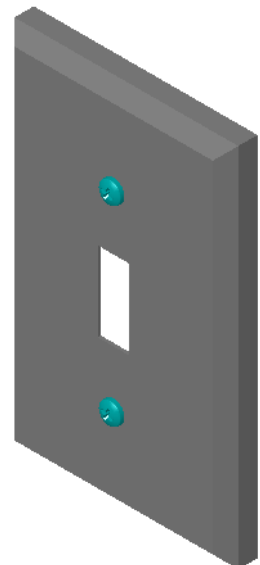
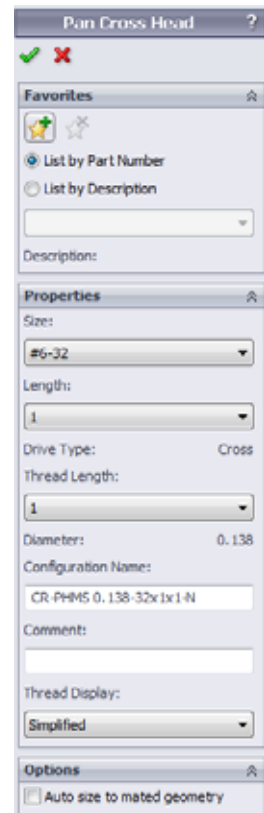
- 1 If necessary, change the properties of the screw to match the holes. In this case, a #6-32 screw with 1" length works with these holes.
- 2 When you have completed the property changes, click **OK** .

The first screw is now placed in the first hole.

- 3 Repeat the process for the second hole.

You should not have to change any of the screw properties for the second screw. Toolbox remembers your last selection.

Both screws are now in the switchplate.



Lesson 5 — 5 Minute Assessment — Answer Key

Name: _____ Class: _____ Date: _____

Directions: Answer each question by writing the correct answer or answers in the space provided or circle the answer as directed.

- 1 How would you determine the size of a screw to place in an assembly?

Answer: Measure the hole and the thickness of the material that the screw has to go through. The hole size determines the size of the screw. The thickness of the material determines the length of the screw.

- 2 In which window do you find ready-to-use hardware components?

Answer: Toolbox Browser.

- 3 True or False: Parts from Toolbox automatically size to the components they are being placed on.

Answer: False.

- 4 True or False: Toolbox parts can only be added to assemblies.

Answer: True

- 5 How can you resize components as you are placing them?

Answer: Use the window that pops up to change the part properties.

Lesson 5 — 5 Minute Assessment

REPRODUCIBLE

Name: _____ Class: _____ Date: _____

Directions: Answer each question by writing the correct answer or answers in the space provided or circle the answer as directed.

- 1 How would you determine the size of a screw to place in an assembly?

- 2 In which window do you find ready-to-use hardware components?

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- 5 How can you resize components as you are placing them?

Exercises and Projects — Bearing Block Assembly

Add bolts and washers to fasten the bearing rest to the bearing block.

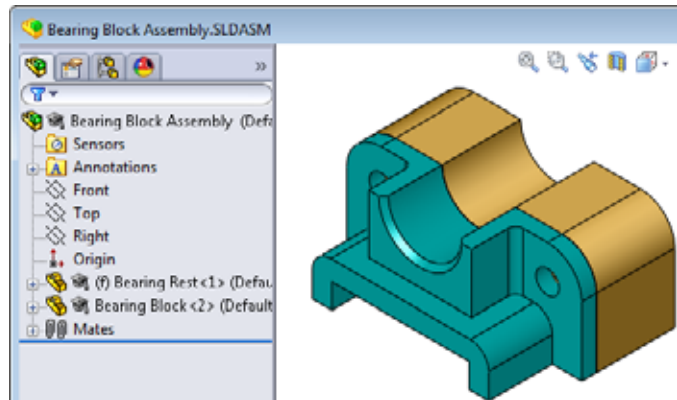
Opening the Assembly

- 1 Open Bearing Block Assembly.

Bearing Block Assembly has Bearing Rest and Bearing Block as components.

In this exercise, you are going to bolt the bearing rest to the bearing block. The through holes in the bearing rest are designed to allow the bolts to pass through but not be loose. The holes in the bearing block are tapped holes. Tapped holes are threaded and specifically designed to act like nuts do. In other words, the bolt screws directly into the bearing block.

If you take a close look at the holes, you see that the holes in the bearing rest are larger than those of the bearing block. That is because the holes in the bearing block are represented with the amount of material needed for the creation of the screw threads. The screw threads are not visible. Threads are rarely shown in models.



Placing Washers

Washers have to be placed before the screws or bolts. You do not have to use washers every time you place screws. However, when you do intend to use washers, they must be placed before screws, bolts, or nuts so that the correct relationships can be established.

The washers mate with the surface of the part and the screw or bolt mates with the washer. Nuts also mate with washers.

- 2 Expand the Toolbox Browser icon   in the Design Library Task Pane.

- 3 In the Toolbox Browser, browse for **Ansi Inch, Washers, Plain Washers (Type A)**.

The valid types of Type A Washers display.

- 4 Click and hold **Preferred - Narrow Flat Washer Type A** washer.

- 5 Slowly drag the washer towards one of the bearing rest through holes until the washer seems to snap onto the hole.

When the washer snaps onto the hole, it is correctly oriented and properly mates with the surfaces of the part that it is combined with.

The washer still may appear too large for the hole.

- 6 When the washer is in the correct position, release the mouse button.

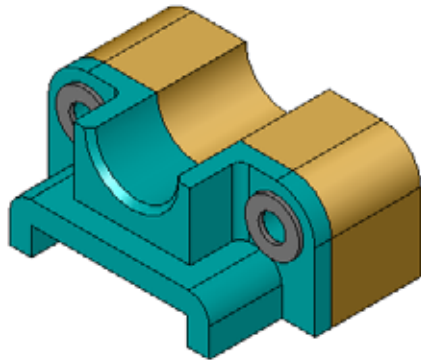
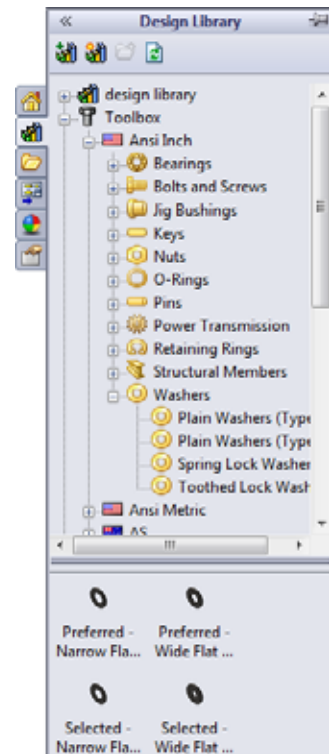
After you release the mouse button, a pop-up window appears. This window enables you to edit the properties of the washer.

- 7 Edit the washer properties for a 3/8th hole and click **OK**.

The washer is placed.

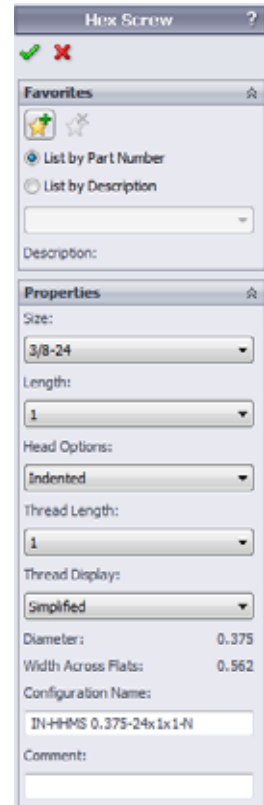
Notice that the inside diameter is slightly larger than 3/8th. In general, the size of the washer indicates the size of the bolt or screw that must pass through it — not the actual size of the washer.

- 8 Place a washer on the other hole.
- 9 Close the **Insert Components** PropertyManager

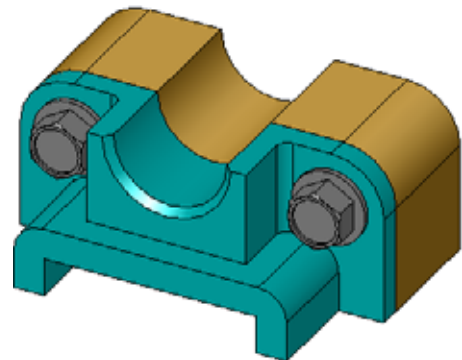


Placing Screws

- 1 Select **Ansi Inch, Bolts and Screws**, and **Machine Screws** from Toolbox Browser.
- 2 Drag a **Hex Screw** to one of the washers that you placed earlier.
- 3 Snap the screw into place and release the mouse button.
A window appears with the properties for the hex screw.
- 4 Select a 3/8-24 screw of the appropriate length and click **OK**.
The first screw is placed. The screw establishes a mate relationship with the washer.



- 5 Place the second screw in the same way.
- 6 Close the **Insert Components** PropertyManager.



Thread Display

While fasteners such as bolts and screws are fairly detailed parts, they are also very common ones. In general, bolts and screws are not the parts that you design. Instead you will use off-the-shelf hardware components. It is a well-established design practice to not draw all of the details of fasteners, but to specify their properties and show only an outline — or simplified — view of them.

The three display modes for bolts and screws are:

- ❑ **Simplified** — Represents the hardware with few details. This is the most common display. Simplified display shows the bolt or screw as if it were unthreaded.



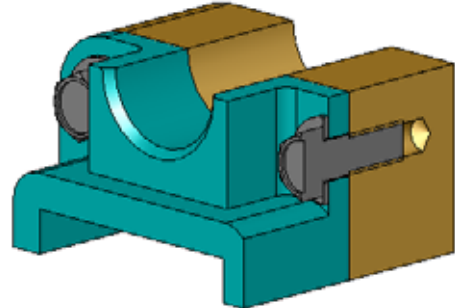
- ❑ **Cosmetic** — Represents some details of the hardware. Cosmetic display shows the barrel of the bolt or screw and represents the size of the threads as dashed lines.
- ❑ **Schematic** — Very detailed display which is rarely used. Schematic shows the bolt or screw as it really appears. This display is best used when designing a unique fastener or when specifying an uncommon one.





Making Sure That the Screws Fit

Before you placed the washers and screws, you should have measured the depth of the holes and the thickness of the washer as well as the diameter of the holes.


Even if you measured before placing the hardware, it is a good practice to verify that the screw fits as you intended it to. Viewing the assembly in wireframe, viewing it from different angles, using **Measure**, or creating a section view are some ways to do this.

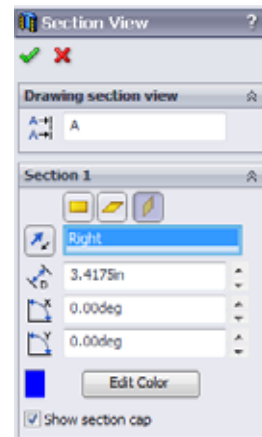


A section view lets you look at the assembly as if you took a saw and cut it open.

- 1 Click **Section View**  on the Heads-up View toolbar.
The **Section View** PropertyManager appears.
- 2 Select **Right**  as the **Reference Section Plane**.
- 3 Specify **3.4175** as the **Offset Distance**.
- 4 Click **OK**.

Now you see the cut away of the assembly right down the center of one of the screws. Is the screw long enough? Is it too long?

- 5 Click **Section View**  again to turn off of the section view.



Modifying Toolbox Parts

If the screws — or other parts placed from Toolbox — are not the correct size you can modify their properties.

- 1 Select the part to modify, right-click, and select **Edit Toolbox Definition**.

A PropertyManager appears with the name of the Toolbox part. It is the window that you used to specify the properties of Toolbox parts as you were placing them.

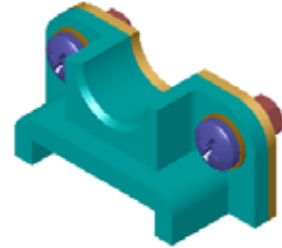
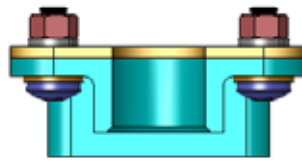
- 2 Modify the part properties and click **OK**.

The Toolbox part changes.

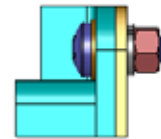
Note: After modifying parts, you should rebuild the assembly.

More to Explore — Add Hardware to an Assembly

In the previous exercise you used Toolbox to add washers and screws to an assembly. In that assembly, the screws went into blind holes. In this exercise, add washers, lock washers, screws, and nuts to an assembly.



- 1 Open Bearing Plate Assembly.
- 2 Add the washers (**Preferred - Narrow Flat Washer Type A** parts) to the through holes on the bearing rest first. The holes are 3/8th diameter.



- 3 Add the lock washers (**Regular Spring Lock Washer** parts) to the far side of the plate next.
- 4 Add 1-inch machine screws with a pan cross head. Snap these to the washers on the bearing rest.
- 5 Add hex nuts (**Hex Nut** parts). Snap these to the lock washers.
- 6 Use the techniques that you have learned to verify that the hardware is the correct size for this assembly.

Lesson 5 Vocabulary Worksheet — Answer Key

Name: _____ Class: _____ Date: _____

Fill in the blanks with the words that are defined by the clues.

- 1 View that lets you look at the assembly as if you took a saw and cut it open: **Section view**
- 2 Type of hole that allows a screw or bolt to be screwed directly into it: **Tapped hole**
- 3 Common design practice that represents the screws and bolts showing outlines and few details: **Simplified**
- 4 Method for moving a Toolbox part from the Toolbox Browser to the assembly: **Drag and drop**
- 5 Area of Design Library Task Pane that contains all available Toolbox parts: **Toolbox Browser**
- 6 A file where you where you combine parts together: **Assembly**
- 7 Hardware — such as screws, nuts, washers, and lock washers — that you can select from the Toolbox Browser: **Toolbox parts**
- 8 Type of hole that allows a screw or bolt into it, but is not tapped: **Through hole**
- 9 Properties — such as size, length, thread length, display type — that describe a Toolbox part: **Toolbox definition**

Lesson 5 Vocabulary Worksheet**REPRODUCIBLE**

Name: _____ Class: _____ Date: _____

Fill in the blanks with the words that are defined by the clues.

- 1 View that lets you look at the assembly as if you took a saw and cut it open: _____

- 2 Type of hole that allows a screw or bolt to be screwed directly into it: _____

- 3 Common design practice that represents the screws and bolts showing outlines and few details: _____
- 4 Method for moving a Toolbox part from the Toolbox Browser to the assembly: _____

- 5 Area of Design Library Task Pane that contains all available Toolbox parts: _____

- 6 A file where you where you combine parts together: _____
- 7 Hardware — such as screws, nuts, washers, and lock washers — that you can select from the Toolbox Browser: _____
- 8 Type of hole that allows a screw or bolt into it, but is not tapped: _____

- 9 Properties — such as size, length, thread length, display type — that describe a Toolbox part: _____

Lesson 5 Quiz — Answer Key

Name: _____ Class: _____ Date: _____

Directions: Answer each question by writing the correct answer or answers in the space provided or circle the answer as directed.

- 1 How do you establish a mate relationship between a Toolbox part and the part it is being placed on?

Answer: The mate relationship is established when the Toolbox part snaps to the other part. You do not have to explicitly define the relationship.

- 2 What does **Edit Toolbox Definition** enable you to change?

Answer: Toolbox part properties such as size, thread display, and length.

- 3 If you need a washer for a 3/8th diameter screw or bolt, is the inside dimension of the washer also 3/8th? If not, why not?

Answer: The inside diameter of washers is slightly larger than the outside dimension of the screw or bolt that it is combined with. This allows the screw or bolt to pass through it.

- 4 How would you determine the correct length of a machine screw that fastens two parts using a washer, lock washer, and nut?

Answer: Measure the thickness of both parts, the washer, the lock washer, and nut. Use a screw that is the next size longer so that the threads of the screw engage all of the threads of the nut.

- 5 How do you select a lock washer from Toolbox?

Answer: In the Toolbox Browser, select **Ansi Inch** (or other standard), **Washers**, and **Spring Lock Washers**.

- 6 True or False. To place a Toolbox part you have to specify the exact X, Y, Z coordinates.

Answer: False.

- 7 How do you specify the location of a Toolbox part?

Answer: You place Toolbox parts by dragging them and dropping them in the assembly.

- 8 How would you measure hole size?

Answer: Use either the **Measure** or **Dimension** commands.

- 9 True or False. Screw threads are always displayed in Schematic mode — showing all details.

Answer: True

Lesson 5 Quiz**REPRODUCIBLE**

Name: _____ Class: _____ Date: _____

Directions: Answer each question by writing the correct answer or answers in the space provided or circle the answer as directed.

- 1 How do you establish a mate relationship between a Toolbox part and the part it is being placed on? _____

- 2 What does **Edit Toolbox Definition** enable you to change? _____

- 3 If you need a washer for a 3/8th diameter screw or bolt, is the inside dimension of the washer also 3/8th? If not, why not? _____

- 4 How would you determine the correct length of a machine screw that fastens two parts using a washer, lock washer, and nut? _____

- 5 How do you select a lock washer from Toolbox? _____

- 6 True or False. To place a Toolbox part you have to specify the exact X, Y, Z coordinates. _____
- 7 How do you specify the location of a Toolbox part? _____

- 8 How would you measure hole size? _____

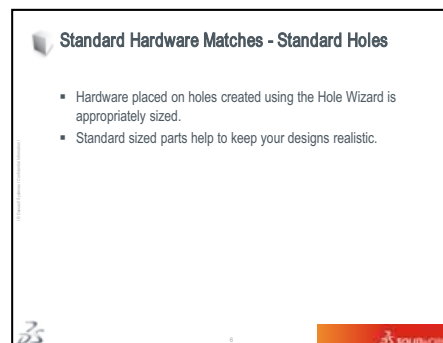
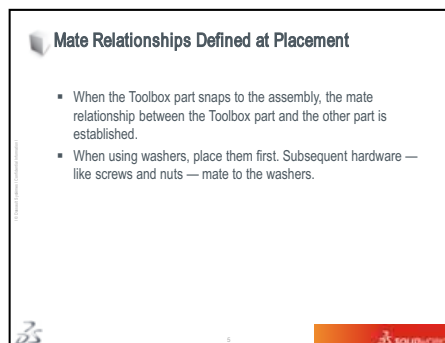
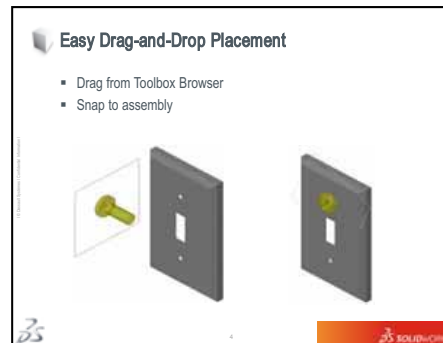
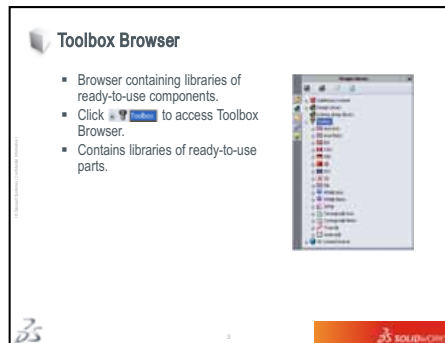
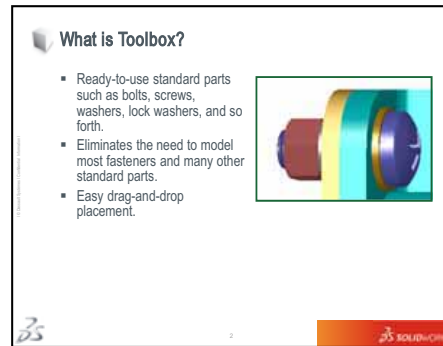
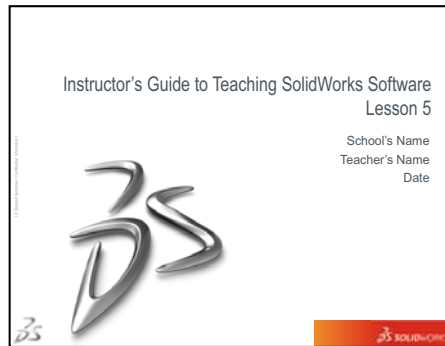
- 9 True or False. Screw threads are always displayed in Schematic mode — showing all details. _____

Lesson Summary

- ❑ Toolbox provides ready-to-use parts — such as bolts and screws.
- ❑ Toolbox parts are placed by dragging and dropping them in assemblies.
- ❑ You can edit the property definitions of Toolbox parts.
- ❑ Holes created with the hole wizard are easy to match with properly-sized hardware from Toolbox.

Thumbnail Images of PowerPoint Slides

The following thumbnail images, arranged left to right, show the PowerPoint slides provided with this lesson.



Specifying Toolbox Part Properties

Change part properties to customize the hardware to your design.

- Specify the properties as you are placing the part.
- Ability to change the properties after the part is placed.



7



Thread Display

- Simplified** — Represents the hardware with few details. Most common display.
- Cosmetic** — Represents some details of the hardware.
- Schematic** — Very detailed display which is used for unusual or custom designed hardware.



8



Supported Standards

Toolbox supports international standards

- ANSI
- BSI
- CISC
- DIN
- ISO
- JIS



9



Libraries from Leading Manufacturers

Toolbox contains standard parts libraries from leading manufacturers such as:

- PEM®
- Torrington®
- Truarc®
- SKF®
- Unistrut®



10

